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Research Article

EFFORT TO REDUCE INDOOR AIR POLLUTION EFFECTIVELY BY USING 'ENVIROFIT' SMOKELESS COOK STOVE IN KOPPAL DISTRICT, KARNATAKA STATE

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Abstract: Worldwide around more than 3 billion people still cook and heat their homes using solid fuels (i.e., wood, crop wastes, charcoal, coal and dung) in open fires and leaky stoves. Majority of them are poor, and live in developing and under developing countries. Such inefficient cooking fuels and technologies produce high levels of household air pollution with a range of health-damaging pollutants. Approximately 17% of annual premature lung cancer deaths in adults are attributable to exposure to carcinogens from household air pollution. The risk for women is higher, due to their role in food preparation. In this background, KVK Koppal has introduced "Envirofit" smokeless and energy efficient cook stoves to reduce household air pollution and the drudgery during cooking for women. Totally 20 OFTs were conducted with 20 farm women in Gondabala, Siddapur Tavaragera, Herur, Kotaliah Camp, villages of Gangavati, Kustagi and Koppal taluks. Extension methods viz. training, method demonstrations and result demonstrations were employed to conduct on farm trials. The study revealed that smoke reduction was observed up to 40 to 50 percent and on an average Rs. 140/- per month was saved on fuel expenditure. Majority of the farm women opined that these stoves are advantageous because they can be easily carried from one place to another, easy to clean the vessels. Now more than 100 farm women have adopted this technology in Koppal district. Gram Panchayats of Kotaliah Camp and Tavaragera Purchased these cook stoves and distributed to women.

Keywords: Household, Women Health, Pollution, Envirofit, Demonstration

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Introduction

Our civilization is biomass based. Every requirement of civic needs is met majorly by biological resources. Wood and other biomass are major fuels for many operations carried out in rural areas and to some extent in urban areas. Examples are cooking, bath water heating, dairy-products making, post-harvest operations, steam generation for a variety of operations, and drying. Traditional devices for these operations, not being energy- efficient, consume large quantities of biomass fuel, thereby contributing to the degradation of ecology and the environment [1,2]. Typically, our food is cooked with the major use of wood a bio-resource has an environmental concern and particularly in dry regions which receive less rains and find difficulty in biomass production.

According to UN report worldwide around more than 3 billion people still cook and heat their homes using solid fuels (i.e., wood, crop wastes, charcoal, coal and dung) in open fires and leaky stoves. Majority of them are poor, and live in developing and under developing countries. Such inefficient cooking fuels and technologies produce high levels of household air pollution with a range of health-damaging pollutants. In poorly ventilated dwellings, indoor smoke can be 100 times higher than acceptable levels for small particles. Exposure is particularly high among women and young children, who spend the most time near the domestic hearth. Cooking in over 90% of rural, half of peri-urban and a fifth of urban homes in our state is generally done in smoky, soot-filled and often dark kitchens in simple stoves that burn fuel-wood incompletely and inefficiently causing a lot of smoke to be produced those spreads into the kitchen. Constant inhalation of smoke brings about various health issues and related drudgery. This smoke creates an environmental threat to sustainability in relation to health. Such a high dependence on fuel-wood as the main energy source for cooking (>200 Mt/yr in India) has often been considered as a threat to the green cover.

This demand is expected to always be on the increase, threatening to create a rapid loss of tree cover. Fuel wood-based cooking is the single largest need for energy in rural areas and accounts for about 30-40% of primary energy use at a country level and therefore at a national and regional level [3].

This forms the single largest threat to the environmental segment of sustainability. During the 70's and the 80's the continued extraction of fuel wood at such rates was considered to threaten the sustainability of the tree cover over India and therefore science and technology alternatives that reduced this threat were urgently required. An early survey showed that about 0.5 tons of wood was consumed by a person in one year to meet the domestic cooking energy needs [4]. They indicate that India consumed about 214 million tons of fire wood per annum during 1996-97, the bulk of which was used for cooking in rural areas. It is also argued that the consumption of firewood on this scale is indeed associated with forest degradation. In another study Geller [5] showed that the thermal efficiency of cooking in rural stoves was in the order of 6 – 9 %. An improvement in the efficiency of cook stoves is hence crucial in conserving the forest biomass. As such in Koppal district the designated forest area itself is 29451 ha (5.33%), and any amount of saving in fuel consumption would help these forest lands. (Koppal District website, Government of Karnataka).

The use of firewood or agricultural residues for cooking is accompanied by two environmental problems. First pollutants like suspended particles, carbon monoxide and unburnt hydro carbons affect the indoor air quality. The study by Jamuna Ramakrishna [6] gave detailed information on indoor air pollution due to use of biomass fuel at different locations in India. The removal of smoke and other pollutants from the kitchen is hence one important aspects of health management of rural women, who essentially spend their most of time.

Secondly The products of incomplete combustion from a cook stove, even if they are removed from the kitchen, can have implication on global warming. Sometimes cooking stoves should essentially have not only the better thermal efficiency but also need to have good combustion efficiency for not to contribute to the global warming [7].

To overcome this potential threat and problems of sustainability we have attempted, multi-pronged solutions. The key approach has been to evolve and disseminate fuel-efficient cook stoves and stoves for other applications that burn wood. One way to take care these concerns through deploy fuel-efficient devices for these operations, particularly cooking which would be the most essential requirement of humanity. Hence the Krishi Vigyan Kendra at Gangavathi took interest in demonstrating and disseminating fuel efficient stoves for farmers for such operations. This paper discusses the on-farm trials conducted for fuel efficiency, followed by the demonstrations and knowledge dissemination potential for the benefit of farming community.

Material and Methods

The study area

The study was undertaken in Koppal district of Karnataka state. It is situated between 15°09'00" to 16°03'30" North Latitude and 75°47'30" to 76°48'10" East Longitude. Koppal district consists of four talukas viz: Koppal, Gangavathi, Kushtagi & Yalaburga. The present study spread in 6 villages of among these 3 talukas except Yalaburga. The villages included Gangavathi, Gondabala, Siddapura, Kaltavaragera, Chukkanakal, Tavaragera, Herur, Kotaiah Camp, villages of Gangavathi, Kustagi and Koppal taluks.

Fuel efficient cook stoves

Stoves for cooking have evolved with a simple concept of tripod stand type, developed with just three stone pieces with an opening in between them. Essentially the air pushed in these gaps helped to burn the fuel faster and the heat generated would also lose to ambience. The conservative efforts to increase the efficiency both for its thermal and combustion were methodically developed since decades. The following are the two concepts utilized for developing fuel-efficient devices

- Carry out the total combustion of the fuel, with as little excess air as practicable, to generate the highest possible temperature of the flue gases.
- Maximize heat transfer to the pans in cooking operations.

Combustion is carried out over a suitable grate in an enclosed firebox, with the requisite combustion chamber volume and ports of proper size, suitably located, for the controlled entry of primary and secondary air, and with an adequate cross-sectional area and height for creating the required draught and dispersing the smoke away from the device, to make it 'smokeless'. Then it takes recourse to the principles of heat transfer to maximise heat transfer for useful work, e.g., to the pans. Heat transfer takes place by conduction, convection, and radiation. It is designed to have high thermal efficiency, it carried out the combustion of fire wood in an enclosed chamber over a suitable grate, with proper openings for primary and secondary air, suitably located, and a chimney, to generate the highest combustion temperature, and then maximize the heat transfer to pans by having:

- an interior compatible in shape to the pans for a higher radiation heat transfer,
- a flue gas passage below the pans such as to facilitate maximum gas-pan contact and as high a velocity of gases as is practical
- cross sectional area with an adequate height and diameter to create a draught and disperse the smoke away from the stove-zone.

On Farm Trial Methods

On farm trials were conducted with a proper demonstration at the beneficiary residence using "Envirofit" smokeless and energy efficient cook stoves Extension methods viz. training, method demonstrations and result demonstrations were employed to conduct on farm trials. Totally 20 on farm trials were conducted with 20 farm women in the selected villages. Demonstrations recorded the cooking time, quantity of fuel used, and the smoke released such that similar observations throughout the study duration by the participant individual. The women who took part in the study further recorded the fuel saved, smoking performance, time

saved in cooking and other observation on their personal opinions. These personal opinions included their opinions on usage and resulted in some benefits, such as less eye burning, ease of vessel cleaning, etc.

Results and discussion

The results of fuel-efficient cook stove usages by farm women were recorded. On farm trials on fuel efficient cook stoves in 8 villages conducted over three years. A total of 20 on farm trials were taken during the study programme. These trials were observed a minimum of 2 months duration and a maximum of 4 months duration. The details of farm trials have been presented in [Table-1].

Table-1 Details of on farm trials

SN	Year of study	No of OFTs	Duration
1	2009-10	7	3 months
2	2010-11	5	2 months
3	2011-12	8	4 months

There have been important advantages observed during the study which are presented in [Table-2]. The primary observations included mainly on the smoking properties of the stove. As the user interested in less smoke such that it would help on their health management reduction of smoke, compared with their traditional devices their reduction in smoke was observed. Fuel expenditure in farm kitchen management have been significant. Any amount of saving on it is a practical help to the farming sector. Amongst the 20 trials conducted in the district the saving on fuel ranged between 120 and 155 Rs/month. It was observed an average of 140 Rs/month as a saving in their fuel expenditure. This saving on cost was reduced by an average of 10.8 Kg/month usage. The fuel quantity saved over the traditional devices ranged between 8 and 15 Kg/month.

Table-2 Advantages of fuel-efficient cook stoves

SN	Parameters	Range	Average
1	Reduction in Smoke	40 – 50 %	44 %
2	Saving on fuel expenditure	120 – 155 Rs/Month	140 Rs/Month
3	Quantity of fuel wood saved	8- 15 Kg/Month	10.8 Kg/Month
4	Saving on cooking time	25 – 40 min/day	32 min/day

Every farm family spent a considerable time in cooking. Saving time in cooking would help the women to utilize the same for other utility effectively or provides some rest between their working tenure. With the introduced cook stove every farm trial individual saved an average of 32 minutes per day. All the trials recorded saving on cooking time ranged between 25 min and 40 min/day.

General opinions of stove users

The study focused on every individual opinion on their participation and the specific advantage of resultant benefits. The benefits of fuel-efficient cook stove included majorly due to less smoke production and associated drudgery reduction. [Table-3]. Present these opinions derived by the individuals participated in the study. Everyone opined that there is less smoke production and drudgery is reduced using the fuel-efficient stoves. Smoke generally disturbs the eyes while at their working phase. As many as 60 percent persons recorded the benefits of less eye burning during their use. Cooking time was also saved with the use of these stoves. About 90 percent of beneficiaries observed the time saving in this kind of stoves. Similarly, the fuel consumption was also reduced that helped in saving money to the individuals. General drudgery for women is at cleaning of vessels. That too the vessels were highly smoked in traditional types require more time and energy to clean. It was observed that the vessels used for cooking with these fuel-efficient stoves could be easily cleaned, as they were less exposed to smoke. Seventy five percent of individuals experienced the ease of cleaning the vessels. They strongly opined that the smoke that produced as such is less and it adhered to bottom of the vessel was also less. Since the stove could be easily carried from place to place it was an added benefit as the farm community could carry the stove even to their farms and cook if required. Everyone opined the benefit of carrying from one place to other add specific advantages. The general opinions of individual were advantageous on their usage of the stoves.

Table-3 Opinions of fuel-efficient cook stove users

SN	Opinion of users	Frequency (Percentage)
1	Less smoke and drudgery	20 (100)
2	Less eye burning	12 (60)
3	Less cooking time	18 (90)
4	Less fuel consumption	18 (90)
5	Easy to clean the vessels	15 (75)
6	More heat retention	16 (80)
7	Easy to carry from place to place	20 (100)

Conclusion

The on-farm trials conducted at KVK Koppal with the introduction of “Envirofit” smokeless and energy efficient cook stoves to reduce household air pollution and the drudgery on women. About 20 on farm trials were conducted with 20 farm women in 8 villages of three talukas of the district. Extension methods viz. training, method demonstrations and result demonstrations were employed to conduct on farm trials. Results of the study revealed that smoke reduction was observed up to 40-50 percent. On an average Rs. 140/- per month was saved on fuel expenditure, and an average cooking time saved was 32 minutes per day as compared to traditional stoves.

Majority of the farm women opined that these stoves are advantageous because they can be easily carried from one place to another, easy to clean the vessels, they retain more heat and burning of eyes and drudgery reduced considerably. The programme clearly brought out the importance of fuel-efficient stoves for farm women as an advantaged simple technological tool. The energy and environmental benefits obtained due to such measure could yield a long-time result. The benefits included saving on time, cost and health expenditure, which have some potential to add additional profits to farm community.

Application of the Research: The research focuses on the relationship between women health and household practices. This will highlight the need and further research for strengthening of awareness programmes in rural households.

Research Category: Agricultural Extension/Women Studies

Abbreviations: OFT-On Farm Trails

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Study area / Sample Collection: Koppal district of Karnataka state

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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